CLAIMS

We Claim:

1. A method of forming an oriented metal layer on a substrate, the method comprising:

placing the substrate in a deposition chamber comprising a source of metal; and

depositing the metal layer onto the substrate by physical vapor deposition of the source of metal under conditions wherein the atmosphere in the deposition chamber comprises hydrogen and wherein the hydrogen is activated, whereby the metal layer has a preferred crystal orientation.

2. The method of Claim 1 wherein the source of metal is a sputtering target and wherein depositing the metal layer onto the substrate is sputter depositing the metal layer by applying power to the sputtering target.

3. The method of Claim 2 wherein the metal is titanium and the titanium layer has a preferred <0002> crystal orientation.

4. The method of Claim 2 wherein the atmosphere comprises argon and hydrogen.

5. The method of Claim 3 further comprising flowing a gas mixture comprising at least 0.1 molar percent hydrogen while sputter depositing the titanium layer.

6. The method of Claim 3 wherein applying power to the target is providing a power density on the target of at least about 0.5 watt per square centimeter of target area.

7. The method of Claim 6 wherein applying power to the target is providing a power density on the target of between about 3 and about 8 watts per square centimeter of target area.

8. The method of Claim 5 wherein the concentration of hydrogen in the atmosphere is at least a factor of 3 higher than the concentration of hydrogen in the sputtering chamber when sputter depositing by a process in which no hydrogen is deliberately introduced into the sputtering chamber.

9. The method of Claim 2 further comprising, after placing the substrate in the deposition chamber:

introducing a quantity of hydrogen into the deposition chamber without providing power to the target.

10. The method of Claim 9 wherein introducing a quantity of hydrogen is flowing a gas comprising hydrogen into the deposition chamber.

11. A method of forming an oriented titanium layer on a substrate, the method comprising:

placing the substrate in a sputtering chamber comprising a titanium target;

flowing a first gas comprising hydrogen into the sputtering chamber through a first gas injector; and

sputter depositing the metal layer onto the substrate by applying power to the metal target and by providing a second gas in the sputtering chamber through a second gas injector, whereby the deposited metal layer has a preferred crystal orientation.

12. The method of Claim 11 wherein the first gas comprises argon and hydrogen.

13. The method of Claim 12 wherein the second gas is an inert gas.

14 The method of Claim 12 wherein the first gas injector is positioned proximate the target.

15. The method of Claim 14 wherein the titanium target is planar and wherein flowing the first gas provides a quantity of hydrogen in the sputtering chamber that is at least 0.5×10^{-4} standard cubic centimeters of hydrogen per square centimeter of target surface area.

16. The method of Claim 11 wherein applying power to the target is providing a power density on the target of at least about 0.5 watt per square centimeter of target area.

17. The method of Claim 16 wherein applying power to the target is providing a power density on the target of between about 3 and about 8 watts per square centimeter of target area.

18. A method of depositing an oriented aluminum layer, the method comprising:

depositing an oriented titanium layer according to the method of Claim 3; and

depositing an aluminum layer overlying the titanium layer, whereby the aluminum layer has a preferred <111> crystal orientation.

19. The method of Claim 18 whereby a full width at half maximum of a <111> X-ray diffraction signal of the aluminum layer is less than about 1.5 degrees.

20. A method of depositing an oriented aluminum layer, the method comprising:

depositing an oriented titanium layer according to the method of Claim 11; and

depositing an aluminum layer overlying the titanium layer, whereby the aluminum layer has a preferred <111> crystal orientation.

21. The method of Claim 20 further comprising depositing a titanium nitride layer overlying the titanium layer, whereby the titanium nitride layer has a preferred <111> crystal orientation.

22. The method of Claim 20 whereby a full width at half maximum of a <111> X-ray diffraction signal of the aluminum layer is less than about 1.5 degrees.